

## CLAIMS

What is claimed is:

- 5           1.       A method for determining a flow parameter of a fluid stream within a  
conduit that extends into a well bore, comprising:  
  
                  deploying an optical fiber to measure a temperature at a location along the  
                                  conduit, the temperature being representative of the fluid  
10                                   temperature at the location; and  
  
                  deriving a flow rate for the fluid based on the temperature at the location.  
  
                  2.       The method as recited in claim 1, wherein the flow rate is a mass flow  
15       rate.  
  
                  3.       The method as recited in claim 1, wherein deploying comprises  
measuring a temperature profile along at least part of the conduit and deriving comprises  
deriving a flow rate for the fluid based on the temperature profile.  
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                  4.       The method as recited in claim 3, wherein deriving comprises deriving the  
flow rate for the fluid based on the temperature profile relative to a natural geothermal  
profile.

5. The method as recited in claim 3, further comprising measuring the temperature profile at a plurality of times and deriving the flow rate for the fluid based on the temperature profile measured at the plurality of times.

5 6. The method as recited in claim 5, wherein deriving comprises calculating at least one constant from the temperature profile measured at the plurality of times.

7. The method as recited in claim 1, wherein deploying comprises establishing a distributed temperature measuring apparatus.

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8. The method as recited in claim 1, wherein deploying comprises deploying the optical fiber in the fluid.

9. The method as recited in claim 1, wherein deploying comprises deploying the optical fiber along an exterior of the conduit.

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10. The method as recited in claim 1, wherein deploying comprises passing light along the optical fiber and receiving light reflected from the optical fiber, the reflected light being indicative of the fluid temperature.

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11. The method as recited in claim 1, further comprising installing the optical fiber in a thermally conductive tube.

12. The method as recited in claim 11, further comprising forming the thermally conductive tube in a U-shape extending along the conduit.

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13. The method as recited in claim 3, further comprising determining the presence of a change in the cross-sectional area of the conduit by analyzing the temperature profile.

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14. A system for determining a mass flow rate of a fluid, comprising:

a conduit extending through a surrounding heat sink;

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an optical distributed temperature sensing device disposed along the conduit; and

an instrumentation device coupled to the distributed temperature sensing device to determine a temperature profile of the fluid for derivation of the mass flow rate of the fluid.

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15. The system as recited in claim 14, wherein the conduit comprises production tubing for the production of oil.

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16. The system as recited in claim 14, wherein the conduit comprises a casing lining a well bore.

17. The system as recited in claim 14, wherein the distributed temperature sensing device comprises an optical fiber.

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18. The system as recited in claim 17, wherein the optical fiber extends from the instrumentation device in a generally U-shaped loop.

19. The system as recited in claim 14, wherein the instrumentation comprises  
5 a laser.

20. The system as recited in claim 14, wherein the distributed temperature sensing device is configured to sense temperature at a plurality of locations along the conduit.

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21. A method for determining a parameter related to fluid flow, comprising:

providing a fluid flow path through a heat sink;

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determining a natural thermal profile along the heat sink;

measuring temperature at a plurality of locations along the fluid flow path

with a distributed temperature sensing system; and

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deriving a mass flow rate of a fluid flowing along the fluid flow path

based on the natural thermal profile of the heat sink and the

temperature measurements at the plurality of locations.

22. The method as recited in claim 21, wherein providing comprises locating  
25 a conduit in an underground formation.

23. The method as recited in claim 21, wherein providing comprises locating a conduit in a well bore.

5           24. The method as recited in claim 23, wherein measuring comprises deploying an optical fiber along the conduit to sense temperature at a plurality of locations along the conduit.

          25. The method as recited in claim 24, wherein deploying comprises placing  
10 the optical fiber in a thermally conductive tube.

          26. The method as recited in claim 21, wherein measuring comprises sensing a temperature profile along a length of the fluid flow path.

15           27. The method as recited in claim 21, wherein measuring comprises sensing the temperature at a plurality of times and wherein deriving comprises deriving the mass flow rate based on the temperature measures at the plurality of times.

          28. A method for determining a parameter related to fluid flow in an  
20 underground formation, comprising:

obtaining distributed temperature profiles with an optical fiber deployed  
along a fluid flow path through the underground formation; and

using the distributed temperature profiles to determine mass flow rates of  
fluid flowing along the fluid flow path.

29. The method as recited in claim 28, further comprising measuring a natural  
5 thermal profile along the underground formation.

30. The method as recited in claim 28, further comprising monitoring the  
mass flow rates of fluid along the fluid flow path.

10 31. The method as recited in claim 28, further comprising calibrating  
temperature measurement via the optical fiber.

32. The method as recited in claim 28, further comprising utilizing a conduit  
to form the fluid flow path.

15 33. The method as recited in claim 32, further comprising producing oil  
through the conduit.

34. The method as recited in claim 32, further comprising producing gas  
20 through the conduit.

35. The method as recited in claim 32, further comprising producing water  
through the conduit.

25 36. The method as recited in claim 28, wherein using comprises

calculating at least one constant from the distributed temperature profiles.